books. However, many industries now deal with materials such as polymers, titanium alloys, and special steels—classes of materials for which parameter data are not readily available. Therefore, it is a very realistic to expect practicing manufacturing technologists to plan experiments to determine parameters that optimize a quality characteristic such as surface finish for these materials.

The specifics of the experiment are (a) *controlled variables*: speed, feed, and depth of cut; and (b) *measured response*: surface finish.

Experiment 2: Injection Molding

The quality of an injection-molded product may be determined by measured quantities such as wall thickness or by attribute-type quantities such as presence of air bubbles and other blemishes. The parameters of the process in this case may include melt temperature, mold temperature, and cure time. Thus, experiments could be conducted to determine optimum process parameters so that a consistent product is obtained. The specifics of the experiment are (a) *controlled variables*: melt temperature, mold temperature, and cure time; and (b) *measured response*: critical wall thickness.

Properly applied, the Taguchi system yields optimum product and process levels that lead to a robust product. Since the procedure identifies these levels during the design stage, it not only lends itself to development of robust products but it is also cost effective and decreases development cycle time.

Hopefully, students and faculty will be encouraged to apply and build upon the fundamental experiments described here. The Taguchi system, experimental design concepts, testing, collection of data, and statistical analysis of data ought to be vital parts of production courses. More advanced work in this area along with other related QA methodologies such as TQM and ISO 9000 are suitable candidates for a second senior-level or graduate class in QA.

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Dr. Sriraman is an Assistant Professor in the Department of Technology at Southwest Texas State University, San Marcos. He is a member of the Alpha Mu Chapter of Epsilon Pi Tau.

2. Preparing Industrial Technology Students for the Impact of the Americans with Disabilities Act

by Kenneth W. Stier

Approximately 48 million people in the United States have one or more physical or mental disabilities (Donaldson, Helmstetter, Donaldson, & West, 1994). This number is expected to grow in the future. People with disabilities represent a significant portion of the population of this country and deserve every opportunity to achieve their full potential.

Historically, the disabled have not had the opportunities that are available to them today. Gautschi (1992) stated that people with physical and mental disabilities were "isolated, segregated, and discriminated against in employment, housing, public accommodations, education, transportation, communication, recreation, health services, voting, and public services" (p. 154).

In 1990 President Bush signed into law the Americans with Disabilities Act (ADA), written to provide equal opportunities to individuals with disabilities. The law took effect on July 26, 1992, for businesses with more than 24 employees. Those with 15 to 24 employees had to comply by July 26, 1994 (Hubbartt, 1991).

Definition

As more research is conducted, new disabilities emerge while others are removed from this classification (Thompson et al., 1994). The ADA defined the term *disability* as "a physical or mental impairment that substantially limits one or more of the major life functions" (Gautschi, 1992, p. 154). According to Gautschi (1992) and Kinsella (1992), this definition would include the wheelchair bound, asthmatic, diabetic, epileptic, manic depressive, dyslexic, HIV-infected, deaf, blind, cancer infected, heart diseased, learning disabled, and rehabilitated drug users. According to Kinsella, individuals with emotional or psychological disorders or mental retardation would also be covered under this definition.

At first glance it would appear that the ADA is all inclusive. However, there are some exceptions that allow employers to circumvent the mandates of the ADA. These exceptions only apply where the employer could show that significant difficulty or expense is involved in order to accommodate the disabled person. According to Gautschi (1992), these include such things as "the nature and cost of the accommodation, the financial resources of the facility, the impact on operations, and the number of employees" (p. 154).

IMPACT OF THE ADA

Thompson, Thomas, and Fernandez (1994) pointed out that one of the most significant aspects of the ADA legislation was that it removed barriers that excluded the disabled from aspects of our society. They quoted President Bush

as having articulated this point at the signing ceremonies. The ADA has caused profound changes in the workplace and in our society (Prior, 1994). However, removing attitudinal barriers in the workplace can be a long and tedious process (Thompson et al., 1994).

While the legal ambiguities in the ADA offer the potential for litigation, the courts have attempted to provide more clarification with regard to the ADA to help resolve these disputes (Thompson et al., 1994). Even though the number of complaints filed after the enactment of the ADA was higher than expected, Prior (1994) expressed optimism about the legislation and observed that the ADA is creating a new workplace culture that reflects heightened environmental concerns by the workforce and should be viewed as the blueprint for the workplace of the future.

Reasons for Optimism

Despite some confusion and panic that originally surrounded the ADA legislation, there is reason for a great deal of optimism now. For example, a study conducted by Louis Harris and Associates, Inc. for the National Organization on Disability showed that companies have not incurred tremendous expenses nor have they been inundated with lawsuits as a result of the ADA being enacted ("Poll," 1995). Other important findings from this study included the following:

1. More than 90 percent of executives support provisions of the ADA that prohibit discrimination in employment and public accommodations and require mass transit systems to be accessible to people with disabilities.
2. Nearly half of executives, or 48 percent, said the costs of accommodating people with disabilities increased "a little," while 32 percent reported no change. Two-thirds, or 66 percent, said the amount of litigation involving their companies hadn't changed under the ADA, while 14 percent said the level increased "a little."
3. Eighty-one percent of companies have modified their workplaces or practices to help employees with disabilities do their jobs, compared with 51 percent in 1986. Such changes include removing architectural barriers, switching furniture, adjusting work hours, and restructuring jobs.
4. A smaller percentage of executives, 57 percent, believe it doesn't cost extra to hire people with disabilities (compared with 79 percent in 1986).
5. Fifty-six percent of companies have established policies or programs to hire people with disabilities (compared with 46 percent in 1986).
6. Sixty-four percent of companies have hired people with disabilities in the past three years (compared with 62 percent in 1986). A lack of qualified applicants was the top reason given for not hiring them during the period.
7. Three-fourths, or 75 percent, of managers said they were "very" or "somewhat" likely to increase efforts to hire people with disabilities in the coming three years (compared to 60 percent who said the same in 1986). ("Poll," 1995, p. D1)

The increasing role that technology is playing to help the disabled develop to their full potential is another cause for optimism. A broad range of adaptive technology products have been created to assist individuals in overcoming disabilities and have been especially helpful to the disabled in the area of education (Guidice, 1993). In some applications, managers have found that robotics and automation are key elements in helping disabled employees to become more productive (Forger, 1993; Patel, 1992).

IMPLICATIONS FOR STUDENTS AND FACULTY

Obviously, industrial technology graduates will be more likely to work with physically and mentally challenged people. Thus, faculty have a responsibility to help prepare students to work effectively with the disabled who will become more numerous in the workforce. One method faculty can use to raise the level of awareness of students with regard to the ADA legislation and needs of the disabled is to contract for projects with organizations that have revenue-generating manufacturing facilities to employ or train the disabled. These organizations and facilities exist throughout the country and often compete with other manufacturing firms for production. These nonprofit organizations assess people's capabilities and then provide job training and employment for people who have physical and developmental disabilities.

The managers of these facilities realize the importance of appropriate technology with regard to improving the potential of the disabled employees and improving the organization's odds of being competitive against any other manufacturing facility (Patel, 1992). Assistive technology is seen as the key to integrating the disabled into the manufacturing industry. However, many times these affirmative organizations do not have the time, personnel, or money to invest in developing assistive technology. This need for process improvements can provide opportunities for technology classes that help to expose the students to people with disabilities.

A capstone course in the Department of Industrial Technology at Illinois State University involves students in projects with a local affirmative agency that uses a manufacturing setting to train and employ disabled people. It is a 4-credit-hour course that meets for 3 hours twice a week and is taken by seniors as a culminating experience prior to graduation. A minimum time commitment of 160 hours (including time outside the scheduled class time) is expected from each student for the semester.

The case of "Company ABC," used in place of the actual company name, exemplifies the course in action.

THE COMPANY ABC CASE

Company ABC is a not-for-profit agency which has been serving in the university region for approximately 30 years. It provides vocational development services, functional skills training, psychosocial support, and/or employment for persons with vocational barriers. The agency has a 34,500 square foot production facility and a 17,500 square foot warehouse, and its 68 employees provide services for approximately 230 persons with disabilities.

Since 1965, ABC has relied on subcontracting as a way to provide training for its clients. When the recession of 1991 severely limited the amount of subcontract work, ABC aggressively developed a Business Service Division. A new logo and image for the agency was developed to break down the traditional image of a "sheltered workshop" and to inform the community what ABC was all about. Marketing efforts and strategy paid off, and in 1992 ABC secured several contracts with major corporations. By 1993, ABC had approximately 93 customer accounts, which included companies in the manu-

facturing and service sectors that provided subcontract services in the following areas: data entry, packaging, mail processing, bench assembly, refurbishing, fulfillment, and inspection/re-work.

The rapid expansion in subcontracting and lack of time or resources to improve existing processes caused ABC to invite the author to determine ways the university could provide assistance. As a result, a contract was negotiated between ABC and Illinois State University to provide assistance. The contract included nine different projects that required the students to design, prototype, test, refine, and eventually produce production models of tooling and machines. The purpose was to help make manual, labor-intensive jobs more efficient and ergonomically acceptable for disabled workers. Service to ABC's customers would be improved by allowing workers and clients to do the jobs more quickly, efficiently, and correctly. In addition to improved productivity, there were other unique requirements. First, ABC did not want the jobs to become automated to the point that they would eliminate the need for the clients/workers; thus, conflicting with the main purpose of the company to provide employment training for people with disabilities. Second, any machines or tooling had to be designed to meet the needs of the client's/worker's disability.

While students had assisted businesses in other experiences, working with ABC provided the additional benefit of having to work with people with special needs. For some students it was their first experience in working with the disabled.

The projects were determined and the contract was finalized in the fall of 1993. In January 1994, the students toured the production facility and received background information. Based on technical background and interest, the 30 students were divided into groups to work on the nine projects in a manner similar to the hybrid approach described by McGourty (1994). Each group was given time to complete a job assessment and then develop a proposed solution. The proposals were presented and evaluated by a review panel consisting of the author, a technology transfer representative from the university, and management personnel from ABC. Once the proposals were approved, the author assisted the students in planning their projects and worked with them in the laboratory to help ensure success. Specialized technical expertise was provided by other faculty and company personnel.

The review panel met with each group approximately every three weeks. The review sessions were used as a means to ensure that projects progressed in a direction that was consistent with the business goals of the company and to evaluate student performance. Technical issues raised during the reviews that required additional time were dealt with at other scheduled times in focused follow-up activities. Decisions to alter or refine the goals, scope, or approach of a project had to be approved by the review panel. This helped ensure that business and educational goals were maintained and kept in balance, and also that changes to projects were known to all parties.

AN EXAMPLE

It was necessary to modify an arbor press to tighten the end couplers around the ends of ballchains. The students proposed an arbor press design with the special tooling, machined the dies out of S7 air hardening tool steel using computer numerical control and traditional machine tools, and mounted them to the arbor press. (Specific technical details and drawings of the Arbor press design may be obtained by writing to the author.)

The design is relatively straightforward. There are two crimping dies. One is mounted to the stationary bottom of the arbor press while the other is mounted to the press arm itself. The bottom die is designed with two pegs to allow the operator to mount the end couplers of the ball chain and then insert the ball chain into the coupler. The top die has two holes that align with the pegs on the bottom die as the two parts squeeze together and crimp the coupler around the ball chain. Prior to the construction of this machine, the disabled people completed this job using pliers, which was time consuming and hard on their hands. The prototype worked so well that ABC purchased the arbor presses and materials to build four more units.

At the end of the semester, several students commented that the nine projects seemed simple in nature or concept but were difficult to implement. Some groups had the concept of a solution in the first week, but it took all semester to prototype and complete the project. Working with company ABC forced the students to consider the clients/workers for whom they were designing the machines. Too often the students designed and built a prototype, assuming that if it was easy for them to use then anyone could operate it. Much to their surprise, the students discovered the opposite when they tried to implement the prototype with the clients/workers. The clients and workers had disabilities that ranged from blindness to memory loss. This caused the students to re-evaluate and refine their prototypes several times before reaching an acceptable solution.

A WIN-WIN SITUATION

The processes at ABC were improved so the clients/workers were able to complete their jobs with less discomfort and physical effort. They were able to work more quickly, efficiently, and correctly. ABC also realized a cost-effective expansion of research and development efforts, access to equipment and laboratory facilities at the university, the experience and guidance of faculty, and the opportunity to gain an outside view of production problems.

The students gained experience in working with people with disabilities. More important, these students should be better prepared to work with disabled people and have a better awareness of the ADA legislation. Students gained a familiarity with working in an industrial environment, began to realize the value of their classroom experiences, and were able to apply what they had learned. Students were encouraged to build a portfolio including copies of their reports and photographs of their project. Additionally, the students networked with ABC's management and gained references for internships or job interviews.

The university and the instructor also benefitted as well by providing community service to a company which aided individuals and the local economy. The university gained positive publicity and provided high quality education to its students.

SPINOFFS

The spinoffs of a project like this can be surprising. At the end of the semester, the local newspaper reported on the projects in the business section. Pictures of the projects and the students were included in the news article. This provided positive publicity for ABC and Illinois State University, and a director of another agency in an adjoining county noticed the article and requested similar work.

Since the first set of projects were completed, ABC has hired three industrial technology graduates. One was the graduate assistant who helped with the projects.

Companies with which ABC contracts have seen the positive results of the students' work and this resulted in additional projects for the class.

Finally, a 1995 presentation about this project at a state conference for rehabilitation facilities received an overwhelming response. Directors and managers of similar agencies from all over the state requested involvement with the university and provided additional opportunities for internships and other forms of student involvement.

The enactment of the ADA has caused profound changes in the workplace and our society. Faculty can help remove attitudinal barriers and support the implementation of ADA legislation by involving students in projects that are focused on the disabled. Through a close working relationship with disabled people, students can begin to experience the difficulties and barriers that prevent individuals from developing to their full potential. They also discover how adaptive technology can help individuals overcome their disability and lead normal, productive lives.

This paper describes one successful approach to create a learning environment that fosters the goal of understanding the change that is occurring in industry as a result of the ADA legislation. As a result our graduates can make a positive contribution to society through their ability to use technology to help disabled workers develop to their full potential in the companies where they are employed. In the beneficial results of this project lies a challenge to industrial technology faculty to adapt the strategy described here or other strategies to ensure that graduates will have the opportunity to confront and overcome the workplace challenges of ADA in a positive, constructive way.

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Dr. Stier is an Associate Professor in the Department of Industrial Technology at Illinois State University, Normal. He is a member of the Gamma Theta Chapter of Epsilon Pi Tau.

3. Tech Prep and Enrollment of African American Males

by Francois D. Song

Hull and Parnell (1991) have presented Tech Prep as a "win/win situation" for all: the community, employer, student, and school. Originally an educational innovation, this program is fairly well established and articulates secondary and higher education and has the potential of producing well-trained workers for industry and competent candidates for two-year colleges. This article uses a pilot study of African American males in a Tech Prep program in Ohio as a basis to discuss relevant challenges and issues. The goal of the study was to identify factors contributing to enrollment attraction for this population group. It may have a unique social status related to joblessness, alcoholism, drug abuse, and inadequate educational opportunities (The Governor's Commission on Socially Disadvantaged Black Males [GCSDBM], 1990) to which Tech Prep should respond.

Because this addresses the unique situation of African American young male students in specific areas such as recruiting, prior preparation, motivation to succeed in the program, and the perception of Tech Prep, readers may